The Coalition Aerial Surveillance and Reconnaissance (CAESAR) Approach to Enhancing the Interoperability of Coalition Ground Surveillance Systems

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ABSTRACT

Over the next decade Canada, France, Italy, and the United Kingdom will deploy new *Ground Moving Target Indicator* (GMTI) and *Synthetic Aperture Radar* (SAR) platforms and processing capabilities while other countries, e.g. Norway and Germany, are developing ground-processing capabilities for data from these sensors. In the same timeframe, the United States will continue to enhance existing sensors and exploitation capabilities. Despite this, no single nation will be able to field a sufficient number of sensors to fully support a sustained, large-scale military operation.

While technically challenging, the ability to share data from different sensors using an agreed format is not the only problem faced when it comes to coordinating the use of multiple assets from several nations. Operational concerns must also be addressed when developing interoperability between nations.

The *Coalition Aerial Surveillance and Reconnaissance* (CAESAR) Project was initiated by seven nations in an effort to maximize the military utility of ground surveillance resources through the development, demonstration and integration of interoperability among these assets. This paper will describe how technical and operational concerns were addressed in order to implement this coalition program.

KEYWORDS

Alliance Ground Surveillance; GMTI; SAR; Interoperability; Coalition

OUTLINE

In order to set the stage, the paper begins with a brief overview of the NATO *Alliance Ground Surveillance* (AGS) project followed by a review of the hardware and data architecture developed at NC3A for achieving technical interoperability. The paper briefly defines the goals of the *Coalition Aerial Surveillance and Reconnaissance* (CAESAR) Project and outline the principles behind the decisions that led to the initial choices for technology enhancement, how and why the operational user was integrated into the project at its initial stages. The paper will also indicate the technological and operational tradeoffs that must be examined when working in the coalition environment and how the use of experiments and exercises has enhanced the existing and near-term interoperability of the CAESAR ground surveillance assets

NATO AGS PROJECT BACKGROUND

Recent advances in technology have made it possible to push the airborne ground surveillance concept in several important directions. Advances in sensor and computing technology allow observation to much greater ranges during all types of weather at any time of the day or night. As well, because of their increased range, the coverage can be over a much greater area providing a complete, theatre-wide, situational awareness as well as target selection capability. Because of the advances in computer processing power and communication systems the information gathered can be delivered in an immediate manner, giving commanders access to a continuous and current picture of the battlefield.

In April 1993 NATO formed an Ad Hoc *Multi-Service Group* (MSG) to investigate the requirements for a NATO AGS capability [AC/259(SURV)D/6 1994]. Following this work NATO established the *Alliance Ground Surveillance* (AGS) project overseen by a Steering Committee consisting of national representatives.

Originally four systems were being studied as primary candidates for the core capability, namely: the Italian *Complesso Radar Eliportato Per La Sorveglianza* (CRESO), the French *Helicoptère d'Observation Radar et d'Investigation sur Zone* (HORIZON), the United States' *Joint Surveillance and Target Attack Radar System* (JSTARS) and the United Kingdom's *Airborne Stand-Off Radar* (ASTOR) systems.

More recently, the approach has been modified to allow for more new development, with the result that NATO nations are now proceeding along three parallel directions. One grouping of nations is conducting a project definition phase for a platform based on a US developed advanced sensor under the *NATO Transatlantic Advanced Radar* (NATAR) project. Another grouping is progressing the *Stand-Off Surveillance and Target Acquisition Radar* (SOSTAR) and a third is developing the UK ASTOR platform. These platforms all offer a *Synthetic Aperture Radar* (SAR) sensor, which is capable of detailed imaging of the ground at considerable standoff distances and the detection, and in some cases identification, of stationary targets. These SAR sensors will have to operate in both a high-resolution *Spot* mode, where a small area is imaged in detail, and a wider-area, lower detail, *Swath* mode. Some sensors also include an *Inverse SAR* (ISAR) mode capable of imaging moving objects with high resolution. Either simultaneously or in an interleaved fashion, these platforms also offer a *Ground Moving Target Indicator* (GMTI) radar mode. This mode facilitates the detection of targets that are in motion at or near the surface of the

earth, again, at a considerable standoff distance. The airborne platforms communicate with the ground stations over one or more system-specific medium and/or high-bandwidth data links.

NATO AGS CAPABILITY TESTBED

For several years the *NATO Consultation, Command and Control Agency* (NC3A) has been investigating the technical aspects of interoperability between national GMTI and SAR sensors under the auspices of the *Supreme Headquarters Allied Forces Europe* (SHAPE). This work goes on in the *NATO Alliance Ground Surveillance (AGS) Capability Testbed* (NACT).

The NACT was established in 1995 in The Hague, Netherlands, with the support of the NATO C3 Agency, SHAPE and six nations. The NACT consists of NATO and nationally supplied hardware and software that allows simulation and operational systems to be interconnected for the purpose of enhancing development efforts, performing experiments, providing demonstrations, and participating in exercises. Within this laboratory environment, it has been possible to provide an accurate representation of simulated platform/sensor pairs so that interoperability of sensor data and exploited data products can be demonstrated and evaluated. Currently, the NACT supports systems (aerial platforms or ground stations) from seven NATO nations. Efforts at the NACT led to the development of a data format that allows systems from the seven nations to share and exploit data about moving and stationary targets [Lenk, 1998].

For the NACT, NC3A provides a secure facility, computers, software, networking hardware, network administration, and additional data required to support interoperability efforts. The NACT also provides a controlled switching capability that allows it to provide connection with other NATO Laboratories within NC3A.

The NACT can be electronically connected to other NC3A laboratories, which support development and operations in TMD, Air Surveillance, C2 development, Electronic Warfare, and Logistics Management. The additional systems that can be linked into the NACT include the: Integrated Command and Control (ICC) system for Air Forces, NATO's SEW dissemination network, TMD *Target Refinement and Nomination* (TRAN) tools, and live and simulated *Recognized Air Picture* (RAP) production capabilities.

The results of the efforts in the NACT led to NC3A and supporting nations providing a level of interoperable national assets to support several experiments and exercises. These efforts have demonstrated the ability to accurately simulate GMTI and SAR sensor capabilities and shown the ability to share, disseminate, and exploit data from live and simulated sensors [Lenk, et al, 2000].

The following text provides a brief outline of the exercises that led up to the initiation of the CAESAR project.

PIE 97

In 1997, France hosted systems from six nations at a military flight test facility south of Paris to perform the *Paris Interoperability Experiment* (PIE). During this experiment, one Joint STARS Aircraft with an associated *Ground Station Module* (GSM) and a *Common Ground Station* (CGS) and two French HORIZON helicopters with two HORIZON ground stations were used to gather data about traffic movement in a prescribed area.

The airborne sensor platforms flew predefined orbits designed to provide surveillance of specific portions of the French countryside. In addition to observing civilian traffic in the area, the French Army provided a number of instrumented military vehicles to support the experiment. The data from the air platforms was sent down to their respective ground stations were it was disseminated among exploitation workstations from France, Germany, Italy, Norway, the United Kingdom, the United States, and NATO. Using the ground stations as intermediaries, each nation's

system could request and receive data from the airborne systems.

The highly successful PIE effort proved that the interoperability capability demonstrated in the NACT could be transferred to fielded national systems.

CENTRAL ENTERPRISE 1998

In 1998, NC3A, with the support of France, the United Kingdom, and the United States provided support for the NATO sponsored exercise Central Enterprise 1998, a large-scale live-fly exercise. In this exercise, simulated Joint STARS and HORIZON assets supported numerous *Combined Air Operations Centres* (CAOCs) by providing support for *Theatre Missile Defence* (TMD) *Conventional Counter-Force* (CCF) capability. The goals of the exercise were to provide near-real time data to cells distributed throughout the Northern Region of NATO to provide Situation Awareness and targeting information.

The simulation developed to represent moving ground vehicles was tightly coupled with live movement of target vehicles in order to provide a robust capability for Time Critical Target development. This exercise proved a concept for disseminating data from a central source to support multiple commands and validated the ability of GMTI sensors to support the TMD CCF role [Flemming, et al, 1998]. The dissemination network is shown in Figure 1.

JOINT EXPEDITIONARY FORCE EXERCISE 1999

During the summer of 1999, NC3A, with the support of France, Italy, Norway, the United Kingdom and the United States provided a simulated *Alliance Ground Surveillance & Reconnaissance* (AGS&R) capability to the *Joint Expeditionary Force Exercise* 1999 (JEFX 99). The purpose of the participation was to evaluate the current ability to produce, disseminate, display, exploit, and correlate GMTI and SAR imagery from multiple sensor platforms in order to increase the air and ground commanders' *Situation Awareness* (SA). In addition, the experiment was used to determine the current state of several national *Intelligence, Surveillance, and Reconnaissance* (ISR) system capabilities that provide GMTI and SAR data for inclusion in the proposed CAESAR project. The participants worked together to demonstrate how multiple sensor assets from several nations could be integrated to provide SA and target information to support multiple echelons of command over a large theatre. This exercise demonstrated the use of the NACT based simulation and exploitation capabilities to provide an integrated, multinational coalition of GMTI and SAR sensors for theatre wide ISR within a US exercise.

The use of the NACT assets to support JEFX 99 provided valuable insight into the use of multiple assets to support multiple echelons of command. It indicated that such use can provide commanders with valuable Indications and Warning and Situation Awareness during the early stages of a conflict. It also provided the first successful demonstration of automated tracking technologies that can be used to provide additional information and to decrease the workload on exploiters.

The exercise highlighted several areas on which to focus in order to improve the technical and operational capabilities possible from coordinated use of ISR assets.

EXERCISE JPOW V / CN00

Joint Project Optic Windmill V (JPOW V) / *Clean Hunter 2000* (CN00) was a large NATO sponsored simulation and live fly exercise involving numerous CAOCs and an AIRNORTH Headquarters component. The overall aims of the exercise were many and varied, but the AGS component was directed towards investigating the tasking, planning, operations, and intelligence aspects of the use of multi-national sensors and exploitation capabilities in a distributed environment. The AGS assets supported components at the Deployed CAOC (De Peel, NL), *Headquarters*

Allied Air Forces North (AIRNORTH) (Ramstein AB, GE), CAOC3 (Reitan, NO), and CCOA (Taverny, FR). Four simulated and two live sensor platforms provided MTI and SAR data to seven different types of exploitation capabilities. This exercise validated the ability to integrate sensor data originating from multiple geographic locations into a single picture available throughout the theatre. A depiction of the network is shown in Figure 2. This was also the first exercise involving live and simulated assets providing inputs into automated tracking units to support time critical targeting.

SYSTEM INTEROPERABILITY

As the technical interoperability capacity of the NACT systems has increased more time has been focused on operational interoperability. It is acknowledged that true interoperability in military operations is not provided simply through the injection of technology. NATO and the NATO nations have formalized this idea in the wording of the NATO definition for interoperability, which is: "*The ability of alliance forces, and when appropriate, forces of partner and other nations, to train, exercise and operate effectively together in the execution of assigned missions and tasks.*" [AAP-6(V)].

In order to train, exercise, and operate effectively together, personnel must understand not only the technology, but also the operational framework within which the personnel and equipment must function. It is not sufficient simply to make information available to different echelons of command. Systems that provide a new paradigm for the production and dissemination of information, despite their potentially revolutionary capability, are constrained by the operational processes and procedures that have evolved to fulfil military requirements. The operational ownership of sensors and exploitation capabilities, the operational chain and the procedures for requesting support, the sensor tasking and exploitation process, and the process for integrating exploited data all affect the effectiveness of GMTI and SAR sensor use. In short, one must consider operational as well as technical issues when developing system interoperability.

The NATO C3 Interoperability Architecture development plan recognizes three different views of interoperability architectures that should be developed: the Technical View, the Operational View, and the System View. This viewpoint has become a key element in the development of interoperability that is described in this paper. A pictorial representation of the different views is provided in Figure 3.

CAESAR

In 1999, seven nations pursuing greater interoperability of GMTI and SAR assets initiated discussions that led to the creation of the CAESAR Project. Over the course of the following two years, the seven nations: Canada, France, Germany, Italy, Norway, the United Kingdom, and the United States; produced and signed the documentation required to formalize cooperative efforts to produce an interoperable capability for Ground Surveillance built around existing or developmental national assets. The Project, which is scheduled to last for three and one-half years, held it's kick-off meeting at NC3A in January 2001.

DECISIONS WITHIN THE COALITION CONSTRUCT

In order to bring the project into being, the CAESAR nations, with the assistance NC3A, worked through the development of a legal framework for cooperation while pursuing a parallel process to produce a project plan. This effort was required in order to ensure that nations and national industries could work together to solve technical issues relating to the goal of interoperability. Since this cooperation could lead to technology transfer, it was determined that the nations would have to work within the legal constraints that would allow such transfer.

The nations determined early in the process that the preferred legal method would be to produce a generic umbrella *Memorandum of Understanding* (MOU) under which any number of projects could be initiated through the creation of a specific *Project Arrangement* (PA) document. The combination of the MOU and PA documents provide the legal framework for how the nations relate to each other in the CAESAR project. In addition, the PA defines the scope and duration of the project, the resources that each nation will allocate to the project, and the deliverables for the project. To participate in the project, each nation in the project was required to provide either a sensor capability or a GMTI and SAR exploitation capability.

As the goals for the project were refined, different methods for implementing the project were reviewed for cost and feasibility. The CAESAR nations determined that the preferred method for implementing the technology improvements would be to implement new or to enhance existing contracts with national industries. However, this meant that there was a need to provide a central location to bring the individual efforts together in order to perform integration tests and validation of the capability. Based on the exercise and operational efforts prior to the CAESAR discussions, the nations determined that the NACT would provide the ideal setting to continue the integration efforts. In addition, the nations expressed a desire to have an independent, unbiased source act as the technical coordinator for the project, to ensure that all nations were adequately integrated and represented in the project. In this respect NC3A holds a special position within NATO, since it is chartered to provide unbiased scientific advice and assistance to NATO military and political authorities. Additionally, the Agency plays a major role in developing, procuring and implementing cost-effective system capabilities to support the political consultation and military command and control functions of NATO [NC3A Website, 2002].

It was in this context, under the recently instituted customer-funding regime, that the CAESAR nations agreed to procure the services of NC3A, both to provide access to the NACT and also to function as the Technical Manager for the project. This required generation of a third document, a *Technical Agreement* (TA), which acts as a contract between NC3A and the CAESAR nations to define the parts played by these parties. The TA was implemented and signed by NC3A and the CAESAR nations. Under the TA, NC3A, as the Technical Manager for CAESAR interoperability efforts, is tasked to provide infrastructure and equipment for CAESAR development and testing activities, in addition to assisting in integration of national assets; providing technical expertise and management; providing support to exercises; achieving desired goals; and providing coordination of technical and operational development efforts. Additionally, NC3A coordinates national inputs to produce CAESAR reports [CAESAR PA, 2001].

The project is organized as shown in Figure 4, with three working groups functioning under the guidance of a Management Team. The Management team is made up of one voting national representative from each nation and the Technical Manager. The national representatives set project policy while the Technical Manager coordinates the day-to-day operations of the project.

PROJECT GOALS

The stated goals of the CAESAR project are to collaboratively develop the operational concepts, architecture and interoperability framework, key interfaces, and the formats needed to meet coalition operations. The Project is designed to focus on developing interoperability among surveillance and reconnaissance assets of the seven CAESAR nations by developing and evaluating technologies for the integration of diverse GMTI/SAR platforms and maximizing the military utility of surveillance and reconnaissance resources through the development of operational and technical

means that enhance interoperability [CAESAR PA, 2001].

The practical implementation of these goals required the development of a coalition *Concept of Operations* (CONOPS), coalition *Tactics, Techniques and Procedures* (TTPs) and the combined technologies that will allow efficient and effective use of ground surveillance sensor platforms in a coalition environment.

The project aims to develop a capability to maximise the military utility of scarce and expensive ground surveillance resources through the development of operational and technical means that enhance interoperability. This includes the ability to share information at the data level and exploited data through the use of electronic tracks or text messages. The method used to evaluate operational and technical improvements would be based on the use of a combination of simulation and live fly exercises.

Numerous systems were proposed for the project. The list of systems included fielded systems such as the US *Joint Surveillance Target Attack Radar System* (Joint STARS), and the French Helicopter *Helicoptère d'Observation Radar et d'Investigation sur Zone* (HORIZON). In addition, developmental and systems in evaluation, such as the Italian *Complesso Radar Eliportato di Sorveglianza* (CRESO), the UK *Airborne Stand Off Radar* (ASTOR), the Canadian Radarsat 2 Space borne sensor, and the US U-2 with the Advanced Synthetic Aperture Radars System (ASARS)-2 Improvement Program (AIP) improvement were proposed. Numerous ground based exploitation capabilities will also be part of the exercise and integration work, such as the Norwegian *Mobile Tactical Operations Centre* (MTOC), the French *Système d'Aide à l'Interprétation Multicapteur* (SAIM), a German *Interoperable Image Exploitation Station* (IIES), and US systems such as the *Joint Services Work Station* (JSWS), *Multiple Hypothesis Tracker* (MHT), and the *Moving Target Indicator Exploitation* (MTIX) workstation are also part of the effort.

The simulated and live systems currently hosted in the NACT or supporting exercises for the CAESAR project are indicated in Table 1 and Table 2.

TECHNOLOGY SELECTION DECISIONS

During the negotiation phase for the project it became apparent that with the number and various types of systems proposed for integration it would be important to provide a very clear focus for the technologies that should be integrated. The decision reached during the Project Definition phase was that only data from GMTI and SAR sensors would be considered for integration. The reasoning behind this was twofold. First, most prior exercise efforts had focused on this aspect of system integration. Second, it is currently possible to accurately simulate the output of GMTI and SAR sensors in the laboratory environment, which provides a capability to test concepts prior to integration of actual systems.

Based on the decision to focus on GMTI and SAR, the next step of Project Definition required an assessment of the technologies that would be required to achieve the project goals. It was determined that the continued implementation of the Common Format was key to the technical interoperability of the systems. However, in order to share and exploit data defined by the Common Format, there were other technical items that had to be included in the overall project. In order to evaluate simulated systems and automated exploitation systems in the laboratory, there is a need to produce accurate simulations of moving vehicles and the environment in which they operate. There is also a need to ensure that vehicles are located on the earth in a common way so that locations passed between systems equate to the same point on the earth. In addition, it was decided that tools to support coordinated mission tasking and a common display of data were desirable. The Project Arrangement states that the technical focus of the project would then be the common data format, common registration, GMTI

exploitation tools, target simulation for scenario generation, and a ground picture display [CAESAR PA, 2001].

Earlier exercises and operational efforts supported by NC3A had indicated that in addition to the requirement to produce data, there is also a need to effectively gather data from distributed locations and then provide the data to locations that will exploit the data. During the project development phase, it was decided that there would be a requirement to develop an architecture to support these tasks, although the specifics of the architecture requirements were not defined. The Project Arrangement states that the Architectural focus of the project would be distributed storage, architecture, and distributed processing [CAESAR PA, 2001].

OPERATIONAL TASK FOCUS

Military representatives were included in the project development effort at an early stage. The military staff included both operators and doctrine specialists, to ensure that the technology enhancements under discussion would fit into the desired operational context. It was during these early discussions that it became apparent that there would be a need for a strong operational flavour for the project. The project definition group recognized that each nation's systems are originally designed to operate within a specific context and in conjunction with national systems, as opposed to within a coalition organization. The group determined that there would be a need to understand how these systems fit within their national context so that their operation within a coalition context could be evaluated for areas that range from system tasking, through operations, to exploitation. The disparate echelons and requirements involved in harmonizing the use of these assets resulted in the direction to produce documents that could be used by the nations and NATO to guide operational use. The project definers decided that the focus for the technology efforts, and in fact some of the most important products of the project, would be provided through the production of a Coalition CONOPS and TTPs. In addition, the operational effort would include producing Military Utility Assessments of the technology as demonstrated during exercises, and would provide guidance for the technology to support coordinated mission tasking and cross-cueing between sensors and sensor modes [CAESAR PA, 2001].

RESULTS

The CAESAR capability has participated in two scheduled exercises since the initiation of the project. The first exercise, Clean Hunter 2001, was a simulation only exercise that took place in June of 2001. The second exercise, Strong Resolve 2002, which took place in March of 2002, was a combined simulation and live-fly exercise. Each exercise has been used to evaluate incremental versions of the CONOPS and TTPs developed by the Operational Working Group and the technology enhancements developed by the Technical Interoperability and Architecture Development Working Groups. Prior to each exercise, the equipment required to support the exercise was brought to NC3A for integration testing and validation prior to the exercise. A pictorial representation of the NACT during such an integration phase is provided in Figure 5.

CLEAN HUNTER 2001

Clean Hunter, an annual NATO live-fly exercise, was conducted from 18 - 29 June 2001, and took place in Allied Command Europe's Northern Region and in Northern France, with live-flying during the periods 18-22 and 25-29 June 2001. The U.S. European Command supported the exercise, which is conducted by AIRNORTH through its CAOCs. Clean Hunter 2001 involved air forces from Belgium, Canada, the Czech Republic, Denmark, Germany, Greece, Italy, the Netherlands, Norway, Poland, Portugal, Turkey, the United Kingdom and the United States. France joins the exercise as part of the

normal training relations that have been established with its Allies.

While Clean Hunter 2001 was a large live-fly exercise it was necessary to simulate the TMD portion because there were no live ISR assets scheduled. The simulated CAESAR assets fulfilled this function during the exercise. The various CAESAR sensor simulations were used to generate target detections for use by the exploitation workstations in support of a Joint Theatre Missile Defence Cell, which was responsible for producing targets for allocated ground attack assets [Taylor, 2002].

The MUA produced as a result of participation in Clean Hunter 2001 stated "*The concept of CAESAR is worthwhile and offers military utility by increasing situational awareness and conserving operational resources. The simulation of CAESAR that was observed was well received by commanders and operators alike.*" However, the MUA also observed that while the concept appeared accurate, it was not possible to truly assess the timeliness that would be made available from real systems, stating that "*Live-fly exercises with actual sensor platforms will be more revealing.*" [Evans, 2001]

STRONG RESOLVE 2002

The Clean Hunter exercise was used to evaluate version 2.0 of the CAESAR CONOPS and to produce the initial draft of the CAESAR TTPs. The lessons learned from that exercise and the resulting MUA led the project to investigate an exercise in 2002 that would include live-fly assets. The exercise selected for the second year of the project was Strong Resolve 2002, a large-scale exercise that took place in the Northern Region of NATO. The goals of the exercise were to exercise, evaluate and improve NATO's ability to rapidly deploy and re-deploy forces from peacetime establishments to crisis areas in Norway. Additionally, the goals were to plan, exercise and evaluate joint and combined Force operations in deterrence and war fighting [under cold war conditions], to exercise transfer of authority procedures between NATO and National HQ- and assigned forces in an joint environment, to exercise Command and Control arrangements in the full range of tasks in crisis and war, and to exercise the Norwegian Total Defence System, including mobilization and intra- theatre movements.

In particular, CAESAR supported multiple echelons of command on both sides of the conflict, providing near-real time data from the French HORIZON system, the US Joint STARS system, and the Canadian Radarsat 1 space sensor. Data was down linked from these assets to a central control point in Værnes, Norway, from which it was disseminated to other users. In total, the CAESAR project supported 5 sites, representing multiple echelons of command from the Joint Task Force Commander and the Land Component Commander at *Joint Headquarter* (JHQ) North in Stavanger, Norway, down through the Corps/Division Main *Tactical Operations Centre* (TOC) for the Blue Forces at Surnadalsøra, and down to the Division TOC for the 6th Norwegian Division and to the Brigade TOC for the US MAGTF forces in Fremo. Additional use was made of CAESAR data by the Norwegian Special Operations Forces who were located in the building adjacent to the CAESAR Control Centre in Værnes.

CONCLUSION

In conclusion, this paper has presented the events that led to the development of a functioning coalition interoperability project within the multi-national environment. To date, the project has demonstrated a viable capability for sharing data from multi-national systems in the successful participation in two large-scale NATO exercises.

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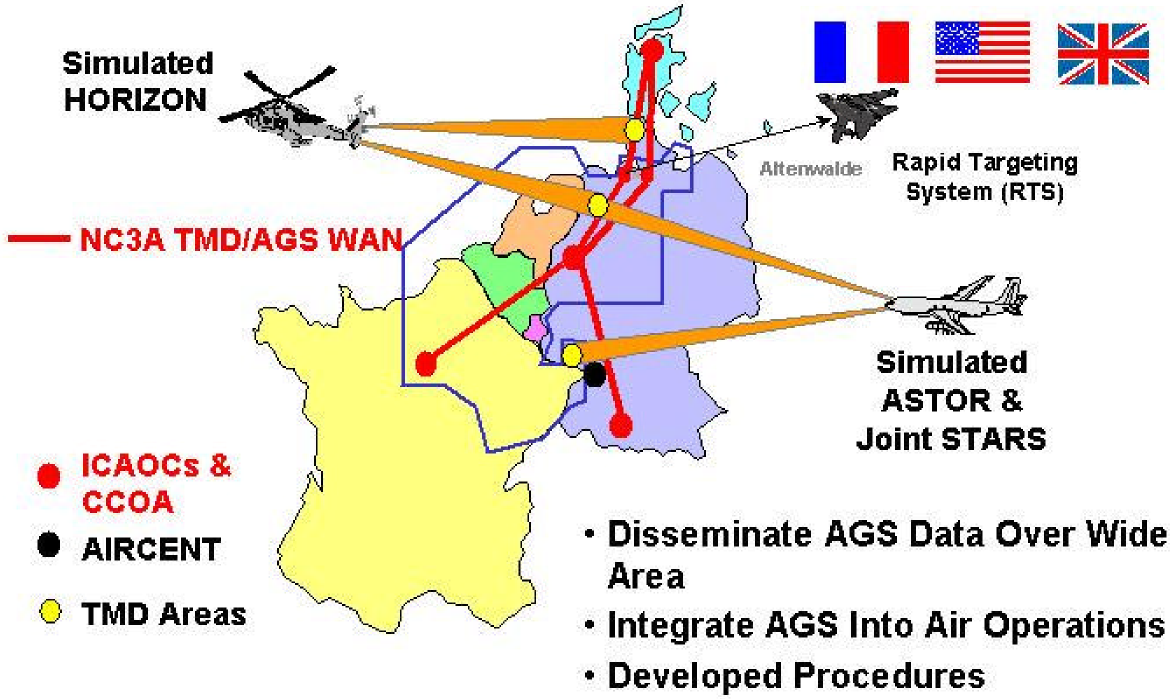

Figure 1: Central Enterprise 1998 Network Dissemination

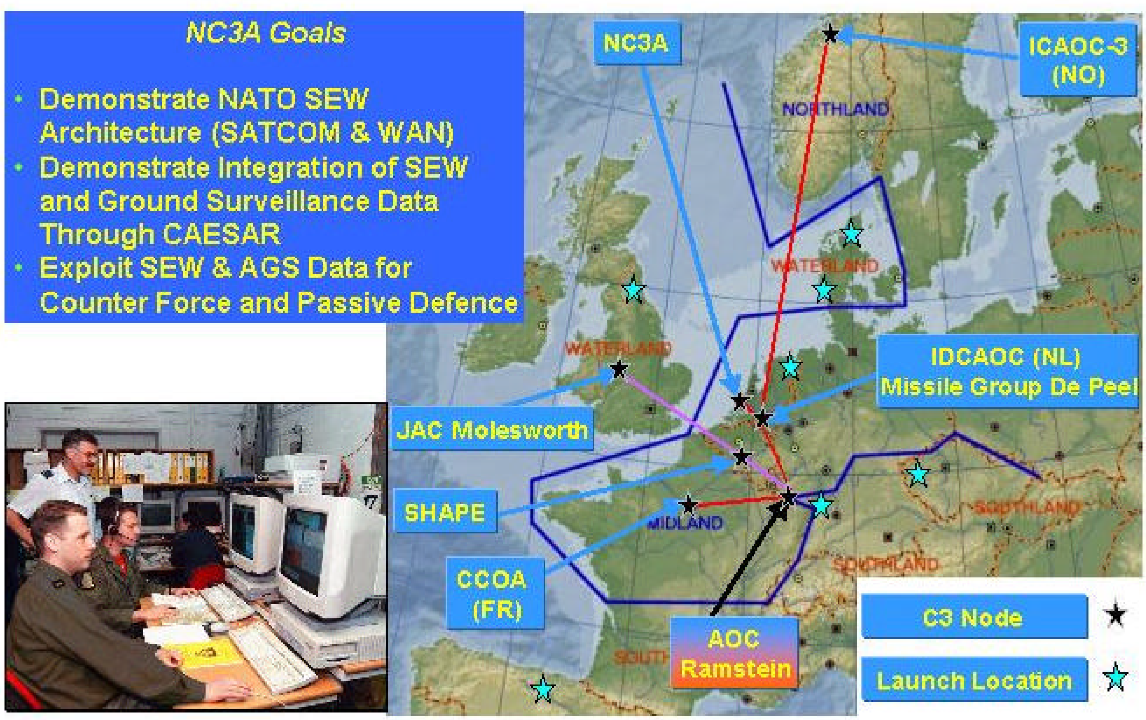

Figure 2: Clean Hunter 2000 Network Dissemination

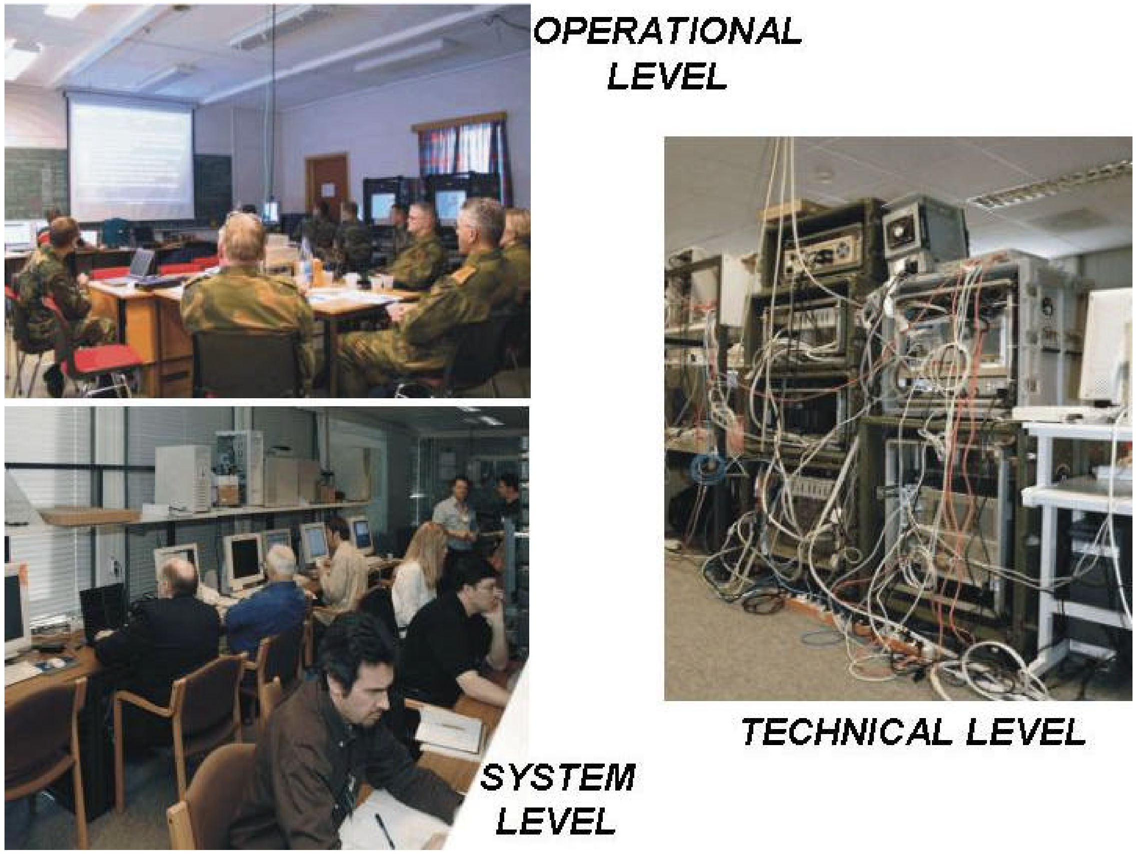

Figure 3: Three Views of Architecture for Interoperability

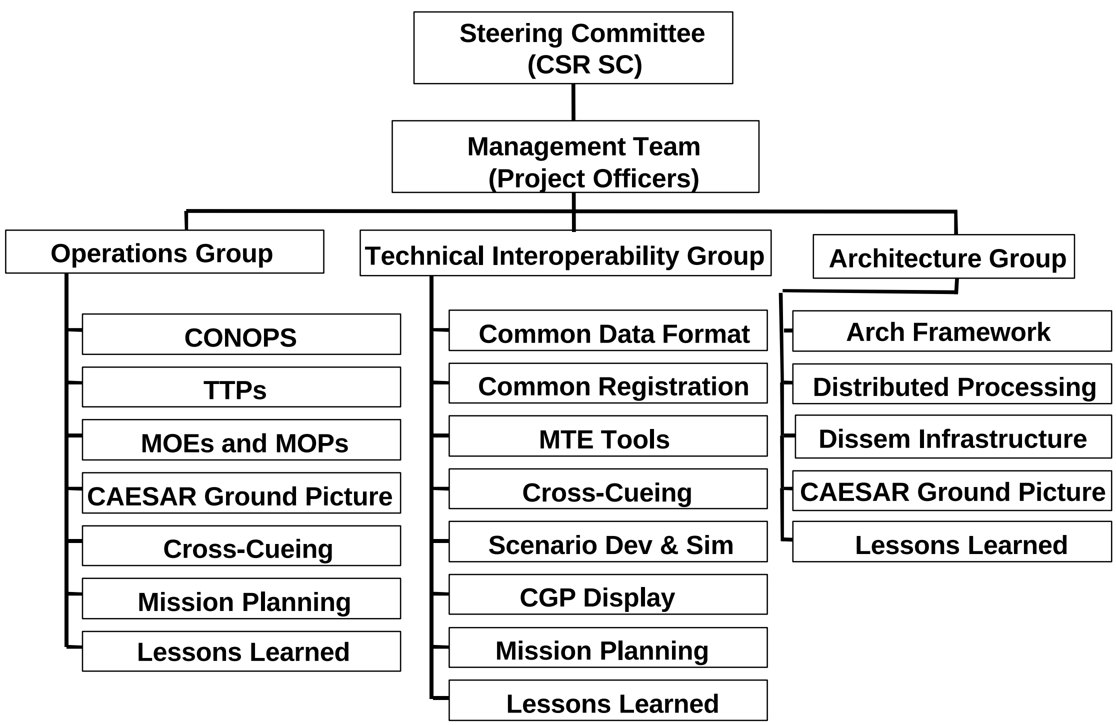

Figure 4: Organizational Structure of the CAESAR Project

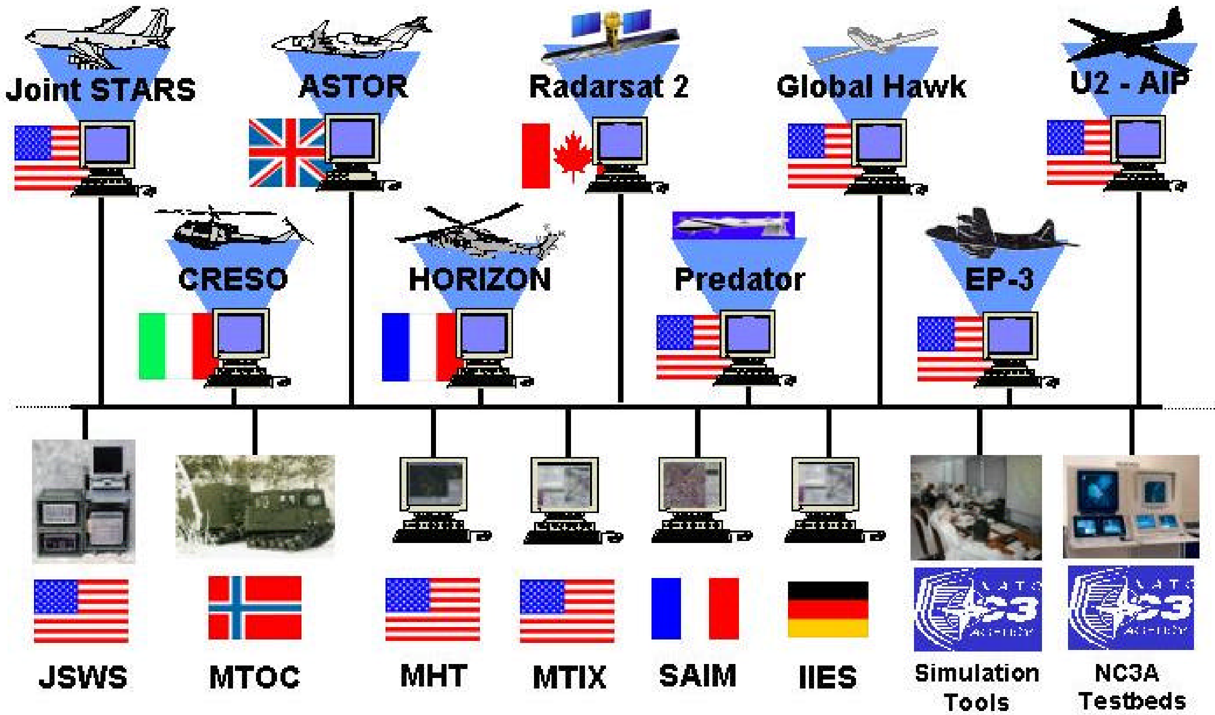

Figure 5: Systems Represented in the NACT

Table 1: Live and Simulated Sensor Systems Supporting CAESAR

Sensor System Name	Live	*Sim*	Nation	Sensor Type		Platform
				MTI	SAR	
Radarsat 1	X		CA		X	Space Based
Radarsat 2		X	CA	X		Sun
HORIZON Helicopter	X	X	FR	X		Super Puma / H-P (Sim)
CRESO		X	IT	X		Motorola
ASTOR		X	UK	X	X	H-P
Joint STARS E-8C	X	X	US	X	X	Militarised 707 / Compaq (Sim)
TACRADAR	X	X	US	X	X	P-3 / Sun (Sim)
Global Hawk		X	US	X	X	Sun
Predator		X	US	X	X	Sun

Table 2: Exploitation Systems Supporting CAESAR

Exploitation System Name	Nation	Sensor Type		Platform
		MTI	SAR	
HORIZON Work Station	FR	X	X	H-P
SAIM	FR	X	X	H-P
IIES	GE	X		PC
CRESO Exploitation WS	IT	X	X	Sun
MTOC Work Station	NO	X	X	Sun
ASTOR Imagery Exploitation WS	UK	X	X	Si Graphics
CREWS 2000	US	X	X	Compaq
MTIX	US	X	X	Sun
MATREX	US	X		Sun
Joint Services Work Station	US	X	X	Sun